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sor Dr. Holtermann, a docent in the botanical institute. The work does not profess to be a verbatim report of Schwendener's lectures (which he himself could not make ready for the press), but is an expression of his views, based upon his lectures, published works, and personal communications; and moreover, the book has had his revision. The contents must suffice to show the character of the work: The mechanical system; Theory of phyllotaxy; Ascent of sap; Stomata; Twining; Tension of cortex; Distortion of pith rays by excentric growth; Apparatus for gliding; Turgor movements; Hygroscopic curvatures and torsion.

To have these topics treated clearly and tersely is extremely useful, and Dr. Holtermann's service will be appreciated.—C. R. B.

**Pflanzenfamilien.**—With the exception of a supplement to the section on lichens, which is in preparation, this monumental work[9] has come to an end with *Lieferung 235*, concluding Brotherus' exposition of the mosses. It has been in course of publication since 1887, the last part being issued in March, 1909. The high appreciation of botanists all over the world must be the reward of the distinguished senior editor, Engler, whose great plan has been so successfully executed. To the publisher, Wilhelm Engelmann, also, are due congratulations for his courage in undertaking so huge a work, whose commercial success must have been problematic at the outset, and for his efficiency in the details of publication.—C. R. B.

## NOTES FOR STUDENTS

**The perithecium of Ascomycetes.**—The whole of Vol. X of *Le Botaniste* is devoted to an elaborate paper by Dangeard[10] on the origin of the perithecium in the Ascomycetes. Pages 1–26 are devoted to a general discussion of the subject, while pp. 27–385 are given over to the description of the individual plants studied. The writer is committed thoroughly to a belief in the autonomous nature of the fungi as a group, and in the derivation of the higher forms from phycomycetous ancestors. He postulates at the outset that the ascus is an organ of the same nature throughout the group; that it had a common origin; and that the slight variations which appear are the results of adaptation. He is confronted with four diverse opinions regarding the nature of the ascus: (1) that it is a modified sporangium; (2) that it is a sporocarp or part of a sporocarp; (3) that it is a mother cell presenting special characters; and (4) that it is a sporogonium. Each one of these theories is then discussed. The first, which is that of Brefeld, regards the ascus as a sporangium in which the form has become fixed and the number of spores definite. This is held to be untenable, since it implies the complete absence of sexuality in the Ascomycetes, and that the phycomycetous ancestors have transmitted to the higher fungi only the asexual stage. Since asexual conidiophores are numerous in the Ascomycetes, the primitive aerial sporangium must have developed along two different lines, giving rise on the one hand to the ascus and on the other to the conidiophore.

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[9] Engler und Prantl, Die natürlichen Pflanzenfamilien, etc. 234 und 235 Lieferung. Brachytheciaceae (Schluss), Hypnodendraceae. Nachträge und Verbesserungen. Von V. F. Brotherus. Teil I. Abt. 3. pp. 1153–1246. Leipzig: Wilhelm Engelmann. 1909. *M* 3.

[10] Dangeard, P. A., L'origine du périthèce chez les Ascomycètes. Le Botaniste 10:1–385. *pls. 1–91.* 1907.

According to the second theory, that of DE BARY, the ascus is either the whole or part of a multicellular structure, the sporocarp, which is the product of the fertilization of an archicarp. The latter is a cell capable of being fertilized, and finds its homologue in the receiving gamete of the alga, bryophyte, or fern. The sporocarp corresponds, therefore, to the oospore or zygospore of the green alga, the sporogonium of the bryophyte, or the leafy plant of the fern. In other words, it is the sporophyte. If all the Ascomycetes developed their asci in the manner of *Dipodascus* or *Eremascus*, this conception of the organ as a sporogonium or sporophyte would hold true, since in these plants the ascus arises directly from the fertilized egg. But DE BARY believed that in the greater number of the Ascomycetes the archicarp gives rise to the whole perithecium, so that the ascus in these cases is not an entire sporogonium but only a part of it, and he regarded it as the equivalent of the spore mother cells in the bryophyte or fern. But it would be remarkable if an organ of such uniform structure should correspond in some cases to a whole sporogonium, and in others to a mother cell only; and DE BARY was in error in thinking that it could be either one or the other according to circumstances.

As to the third theory, the author remarks that, however strange it may seem to homologize asci with spore mother cells, it must be admitted that a certain analogy exists in the limited number of divisions in the ascus to form the spores. If the whole perithecium really arose from the fertilization of an egg, no serious objection could be urged against this homology. But the fruiting body of the Ascomycetes has a mixed origin, since part of the envelope is formed from filaments of the gametophyte. The following additional facts are regarded as antagonistic to this view: (1) In the small number of genera in which the gametangia are still functional, the egg gives rise directly to the ascus, as in *Dipodascus;* (2) in the other genera the gametangia are no longer functional, and the perithecium does not develop from the egg; (3) the formation of the ascus is always preceded by a fusion of nuclei, and no case is known in which the formation of mother cells is preceded or accompanied by a phenomenon of this kind; (4) in the lower siphonaceous fungi, from which the Ascomycetes have arisen, there is no organ which corresponds to mother cells, but one finds on the contrary the sporogonium (oospore, etc.), which is evidently the ancestor of the ascus.

Much discussion is devoted to HARPER'S contention that the fusion of nuclei which precedes the formation of the ascus is without sexual significance. Three points are considered in this connection: (1) the binucleate structure of the ascus; (2) the fusion of the two nuclei into one; (3) the reduction in the number of chromosomes. Against HARPER'S contention, that the binucleate condition of the ascogenous cells is the result of the stimulus of excessive nutriment, it is urged that the rôle of nutrition is secondary in nuclear division; that more importance should be attached to the proportion of carbon compounds in the protoplasm and to tendencies transmitted from ancestral forms; and that the constant occurrence of two nuclei has more than a nutritive significance. Their fusion must be regarded as of a sexual nature because of the fusion of two energids into one; because the result of the fusion is a sporogonium as in the case of the ordinary egg; because nuclear fusion necessitates a reduction of chromosomes; and because the formation of gametes on the gametophore recalls exactly the transformation of sporangia into conidiophores and has the same cause.

The author believes that the nuclear fusion in asci and basidia really represents the sexual reproduction in the higher fungi, and that the fourth theory mentioned is the true one, viz., that the ascus is a true sporogonium in all species and is therefore sporophytic in its nature. He believes that the primitive ancestral phycomycete had a greater or less resemblance to *Myzocytium vermicolum.* It possessed a thallus bearing sporangia, which, in his opinion, represented the sporophytic stage. The sporangia were very susceptible to external conditions. This was followed by a thallus bearing gametangia, the gametophyte; the fused gametes gave rise to the fertilized egg, which on germination produced a new sporangium or *sporogonium* with the characters of an ordinary sporangium, but with the doubled nuclei. This sporangium was but slightly susceptible to external conditions. The author believes that this point should be strongly insisted upon, that the ancestral type possessed two sorts of sporangia: the one responsive to environment has given rise, under the influence of aerial life, to the various types of conidiophores met with in the Ascomycetes; the other, of sexual origin, has been modified but little and has given rise to the ascus.

The author proposes a new classification of the Ascomycetes, based on the reproductive organs, in which the whole group is divided into two, the *Gamétangiées* and *Gamétophorées.* The first possesses functional gametangia and includes *Dipodascus* and *Eremascus.* In the second the gametangia, if present, are no longer functional, and their place is taken by gametophores.

About forty-five different types of Ascomycetes are described and figured in the major portion of the paper. One cannot but marvel that a single investigator could have found time to study all these forms in detail and with thoroughness. A most confusing use of terms makes the whole discussion difficult to follow.—ELIAS J. DURAND.

**Algal-animal symbiosis.**—KEEBLE,[11] continuing his interesting experimental investigation of the associations of unicellular algae with the low animals occurring on the larger seaweeds living between and just below the tide-limits on the north coast of France, now reports the occurrence of a unicellular brown alga in *Convoluta paradoxa*, a tubellarian. He had previously found a green Chlamydomonas-

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[11] KEEBLE, F., The yellow-brown cells of *Convoluta paradoxa.* Quart. Journ. Micros. Sci. 52:431–479. 1908.